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## Some Outcomes in Studying Nanothematic Documentary Flow in Siberian Branch of the Russian Academy of Sciences Based on INSPEC BD Data

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### Abstract

**Based on the Inspec's data, the results of information search carried out using specialized terms, after studying the dynamics of their use for 2000-2011 years of publications, were diagnosed; analyses of publishing interactions among SB RAS scientific centers are shown.**

**Keywords:** Inspec, publications of SB RAS scientists, nanoscience and nanotechnology, nanothematic terms.

### I. INTRODUCTION

Evaluation of the Russian contribution to nanotechnological development (NT) arouses professional interest of experts in various fields [9, 10]. Our study is focused on its Siberian constitutive. One of the tasks of SB RAS integrative project N 37 "Scientific-metrical investigation of the current state, tendencies, dynamics and developmental prospects for NT contributions at SB RAS" is an objective characteristics of SB RAS contribution to the creation of NTs on the national scale and worldwide for the period of 2000-2013 by means of scientific-metrical indices obtained by processing the information from relevant on-line DBs. The present contribution makes a step in this trend using Inspec DB. The following four points are outlined and resolved in it:

- a) Revealing a number of SB RAS publications by searching over regional capital scientific cities: Buryat, Irkutsk, Kemerovo, Krasnoyarsk, Novosibirsk, Omsk, Tomsk, Tyumen, Chita and Yakutsk;
- b) studying the dynamics in the use of specialized terms to determine priorities in this search;
- c) searching nanothematic publications of a region using specialized terms,
- d) studying the interaction of publications among SB RAS scientific centers (SB RAS SC).

As for terminology, American scientists formulated the definitions of the notional triad in connection with NTs: "nanoscience deals with basic research in nanomaterials properties and phenomena on the nanometer scale, nanotechnology — with the creation of nanostructures, nanoengineering — with the search of effective methods of their use" [6]. We consider nanothematics as a whole using the systemic approach.

As is known, Inspec DB (Information Service for Physics, Electronics and Computing) is generated by the British Institute of Electrical Engineers. It is the leading referential DB that registers scientific and technical publications in the field of physics, electrotechnics, electronics, communication lines, automatic control, computing devices, information technologies, mechanics and it has more than 11 mln. documents. Searches over this DB were carried out in April - May 2012. Registrations of found publications were exported from the DB in html. format and saved in the ISP library server, chronological points being January, 2000 and December 2010 which are, presumably, most probable to completely register the material. The scientific documentary flow of the following years will be studied later, as information appears in the DB. Some "fine" peculiarities in dealing with the DB, when searching regional narrowly specialized thematic and chronologically limited publications, were dwelled upon by the authors [11] at the conference "Strategy for Russian Regions Sustainable Development". (Novosibirsk, 4 May, 2012).

### II. RESULTS AND ANALYSIS

The results of searching on the names of SB RAS SC cities are presented in Table 1 according to a decreasing number of publications which total number was 25409 or 0.23% from the whole volume of Inspec documents.

To find nanothematic publications among them, a selection of specialized terms was made.

When discussing specialized terms in nanothematics, it is clear that these are, first of all, the words including the morpheme "nano". In modern Russian reality, when the 'nanotrend' became of state priority in the development of science and technics, it is logical that every author tends to indicate the connection of one's contribution with nanothematics — if not in the heading, then in key words or an annotation. Considering the thing that Inspec DB arranges its search activities over fields "Subject, Abstract, Inspec Heading, Key Phrase Heading Classification, International patent Classification", the introduction of this morpheme in the search field, as we hypothesize, is capable of providing the completeness of the final result at not less than 80%. How is it possible not to lose 20% per cent of the information left? What other specialized terms is it possible

to use when searching information?

The whole seriousness of the problem and non-univocality of answers is proved by numerous literary sources in which it is dwelled upon. The Technical Commission for Standardization are developing the national standard GOST R (State Standard) "Nanotechnologies, terms and definitions". Its project was worked out in 2009 [5]. The terms and key words analyzed in a number of publications [1, 2, 3, 7] laid ground for our search activities. First, a general list was compiled and essentially overlapping terms were eliminated. For instance, it is obvious that "lithography" [3, 5] includes "electron lithography" [3, 5] and "x-ray lithography", and "ion lithography" [5]. Therefore, searching on the first word can help embracing all the four concepts. The other example is: "quantum dots" [1] may be indicated in literature not only as "semiconductor" [1], but also, e.g., as germanium or arsenide/gallium. Thus, the search on the first word-combination is supposed to be more complete also including publications quantitative indices with the second term.

Then we added to the list some topical terms from "ROSNANO" OJSC dictionary [8] and other scientific sources [4, 5], and the presented monolingual concepts were complemented with the English/Russian translation. It made 148 terms. Then a change of frequency of their use in scientific publications over years, assisted with the search over the whole DB material, was studied. In our case, studying the dynamics did not pursue the scientific-metrical aim (indices of one DB are sufficient to reach its indices). It was necessary to determine the searching priorities. According to searching results, the terms were divided into 3 groups: those with ascending, even (steady) and descending use. These are 100, 20 and 28, respectively.

TABLE 1  
Number of SB RAS publications for 2000-2010 on Inspec data

City	Novosibirsk	Tomsk	Krasnoyarsk	Irkutsk	Omsk	Yakutsk	Kemerovo	Ulan-Ude	Tyumen	Chita	Beero
Number of publications	13020	7406	1836	1648	527	399	260	157	155	1	25409

TABLE 2  
Number of collaborative publications of scientists from different SB RAS SCs obtained after Inspec DB data processing for 3675 documents (search-revealed and assisted with "nano"/"no nano" morpheme on "monosemantic" terms)

City	Tomsk	Krasnoyarsk	Irkutsk	Omsk	Yakutsk	Kemerovo	Ulan-Ude	Tyumen
Novosibirsk	20/5	14	2	2	2/4	0	5	0
Tomsk		1	1	0	0	0	0	0
Krasnoyarsk	0		1/1	0	0	1	0	0

Working at Inspec data, it is the volume of its material and searching possibilities that we had to look at. If a word is encountered in the DB rare and rarer, there is less reason for searching it; especially if to consider the thing that a search is to be made in the material which is quantitatively equal to less than a quarter of 1 percent (0.23) of the whole data array. Therefore, a group of 28 specialized terms whose indices of use decreased in 2009, compared to 2000, was defined as a part of words with weak searching possibilities. Moreover, it is common knowledge that the world's information flow is decreasing annually and, on the background of this increase, the application indices of 20 terms in 2000 and 2009 are approximately equal; then, as we believe, they make them closer to the group of decreasing use. In this connection, a part out of 100 terms with a progressing frequency of use in scientific literature was accepted to be called the prior group of words for searching activities. Working at them was continued on the search of SB RAS publications assisted with the searching formula «(Novosibirsk OR Tomsk OR Krasnoyarsk OR Irkutsk OR Omsk OR Yakutsk OR Kemerovo OR Ulan-Ude OR Tyumen OR Chita) t<sup>1</sup> t<sub>2</sub> t<sub>3</sub> "NOT nano\*».

Both basic scientific terms and "young" concepts became to belong to this collection. Herein, if the total 10-year number of using the latter is not big in natural numbers and the growth of using them is considerable (**graphene, metamaterials, plasmonics, spintronics**), then the indices of the first ones are an order higher under smoother dynamics of their use in literature (**condensed state, films, surface structure**, etc.).

As a result of searches on 100 specialized terms, lists out of 10139 publications with the presence of 81 terms were compiled by the system. There were separate searches carried out on the names of SB RAS SC capital cities together with the specialized term having "nano" morpheme, in which the exclusion of some homonymous words (NaNO<sub>2</sub>, NaNO<sub>3</sub>, nanolitre) was meant. It made up 2320 contributions. It is quite obvious that it is difficult to analyze a 4.4 times bigger number of documents (10139) as "raw material" for further intellectual processing to reveal the nanothematic: it takes up much time. Therefore, it was decided to realize such a processing during 3 stages. The results of the first two stages are presented below.

At stage 1, articles with terms that denote substances physical properties or phenomena that proceed exclusively at the nanolevel (**graphene, quantum computer, quantum dots**, etc.) were out-discerned.

There were 26 terms that directly refer to nanothematics, and the number of publications with the use of these terms was 1041.

At stage 2, publications with the terms that can be used to describe a material's physical state, both in nanomeasurement and others, depending on the conditions of investigation and application, were considered. There were 55 such "polysemantic" and "dependent" terms, and 9098 publications which they are used in. To get a general view about the tendencies of nanothematic content transmission using them, there was an arbitrary choice of testing 6 terms (10.9%) encountered in 918 documents

<sup>1</sup> A word or a word-combination expressing a specialized term.

(10.1%). These are **germanium, cluster, luminescence, self-organization, size of particle, electrophoresis**. The testing (selective survey) resulted in 314 publications. The possibility of analyzing the material was provided by saving the left exported material at stage 3.

Further on, all the obtained results were studied on one more criterion. To diagnose SB RAS SC publication interaction, a DB was made up on the Institutes server based on the processed 3675 registrations exported from Inspec, consisting also of 3 parts (2320 registrations revealed by "nano"-assisted search, 1041 — "monosemantic" without "nano" and 314 "dependent"). After that, there was an automated selection of co-authorship contributions into a separate collection of papers. It had 49, 10 and 0 publications, respectively. Analyzing them allowed us to make up a "map" for carrying out collaborative scientific investigations (Table 2) which may be recommended and considered as a resource of SB RAS integrative nanometrical projects.

In parallel, automated data processing for revealing co-authorship publications helps us find out part of publications that does not belong to SB RAS authors. These are conference proceedings that belonged to the general list of results for the reason that the indicated names of cities were the place of holding conferences.

TABLE 3  
Structure of SB RAS nanothematic documentary flow for 2000-2010 on searching results assisted with specialized terms in Inspec DB

Search terms	«nano»	no "nano" morpheme		Total
		"monosemantic"	"depenent" (conditionally)	
1	2	3	4	5
Number of publications	2107	1003	1601	4711
		2604		

Eliminating them decreased a number of papers compiled on formal traits of searching demand with the help of a city's name and "nano\*" by 164 points, by 19 — with cities names and terms with no "nano", by 19 with the "monosemantic" and by 2 points with the "dependent". The number of co-authorship publications (Table 2) — quantitatively dubbed — was equal to 49 in the first case and to 10 with the "monosemantic" in the second case. Besides, a number of dubbed versions that occurred due to the overlapping of key words was found and eliminated. Thus, 9 such superpositions were encountered in "monosemantic" terms and 150 — with the "dependent". The total was 2107, 1003 and 162, respectively. Presently, it is a ready-made result of 3272 registrations for merging with searching results in other DBs by other project participants and their general processing.

All the data are confined to Table 3 in which the index of column 4 was made conditionally based on the following thing. According to the theory of probabilities,

this result may be extrapolated onto all 9098 publications, part of which is supposed to be processed at stage 3, and it may be conditionally believed that the number of nanothematic publications among them is also equal to 17.6%. It will be possible to eliminate the error and make all the necessary amendments after the whole data array processing.

The ratio of indices in columns 2 and 3-4 (Table 3) radically denied our first supposition about the ability of "nano" morpheme of providing the completeness (wholiness) of searching results at 80%. The data of Table 3 allowed us to determine the grounded approaches to the selection of specialized terms for further searching activities of SB RAS nanothematic publications.

As is seen, all the above-formulated became an additional proof for the necessity of thorough and longtime processing of the obtained material compiled by the search system (here Inspec) for the selection of publications and data presentation to DB "Proceedings of SB RAS RU staffers on nanostructures, nanomaterials and nanotechnologies" which the Project is aimed at.

### III. CONCLUSION

The **general conclusion of this researchwork is confind to the following**. Searches for studying the dynamics in the use of 148 terms in Inspec DB, finding out SB RAS publications per 100 of them and exporting 10139 documents, including 81 terms, for further intellectual processing were carried out. The outcomes of the arranged searches allow us to make some generalizations and determine approximate ratios.

1. Comparison of data in Table 1 (25409) and Table 3 (column 2 — 2107) clears out the thing that SB RAS nanothematic publications found with the help of cities names and the "nano" morpheme are equal to 8.3% of the whole regional documentary flow.

2. Searching «nano\* NOT, NaNO<sub>2</sub> NOT NaNO<sub>3</sub> NOT nanolitre 2000-2011» showed up the presence of 378105 nanothematic documents in the DB. The extended search carried out for comparison on field "Country" with the introduction (entering) the word "Russia" resulted in 5382 contributions. Thus, from the comparison of indices "total : Russia : SB RAS", there comes up the ratio of 100% : 1.42% : 0.56, "Russia : SB RAS" being 100% : 39.1%.

3. The data of Table 2 present a trinity of leaders in the nanometrical publication interaction of SB RAS SCs, such as " Novosibirsk — Tomsk, Novosibirsk — Krasnoyarsk and 'Novosibirsk — Yakutsk". Alongside with this, they are indicative of weak interaction of SCs; scientific contributions are 1.8% of SB RAS nanothematic publications.

4. Indices of Table 3 reveal the proportions of searching results assisted with specialized terms "nano\*" : the terms directly related to nanothematics : essentially dependent on the conditions of investigation or application, and they are 44.7% : 21.3% : 34%.

The basic practical outcome of the work at Inspec DB, at this stage, is creating an intermediary base of 3272 nanometrical contributions of SB RAS staffers with the function of revealing dubbed documents.

The continuation of the conducted study could be

both stage 3 of intellectual data processing from DB array with the "dependent" terms and its replenishment with new searching results and a choice of methodology to evaluate SB RAS contribution to the creation of NTs worldwide.

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